Procedia Engineering, 2017, vol.206, pages 1069-1074

# Study of Deformations Field in the Working Zone of Vertical Milling Machine

Khusainov R., Sabirov A., Mubarakshin I.
*Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia*

## Abstract

© 2017 The Authors. Published by Elsevier Ltd. The paper examines the questions of the static elastic deformation development during the machining with milling machines. It discusses the issues of "machine - tool - instrument - workpiece"system modelling aiming at providing the preliminary assessment of elastic deformations during the processing, which gives an opportunity to prevent defect appearance. The deformation distribution is detected for the cases when the cutting area is positioned in different points of working area of the machine. The changes of deformations for different cutting pattern are analysed, a method of determination of main axes rigidity is considered based on that. The results show that the deformation of the technological system depends not only on the geometry of the basic parts and junctions but also on their location. The modelling the whole technological system is required. Only in this case selecting the optimal tool and its location to achieve the required quality of processing is possible.

http://dx.doi.org/10.1016/j.proeng.2017.10.596

## Keywords

finite element analysis, machine tools, rigidity

## References

[1] D.T. Safarov, K.A. Fedorov, and A.I. Ilyasova Algorithms development of making special techniques in APQP manufacturing process of automotive components Mater. Sci. and Eng 134 2016 012036

[2] S.V. Kas'yanov, and D.T. Safarov Diagnosis of technical state of equipment and tools according to indices of technological accuracy Avtomobil'naya Promyshlennost 5 2004 24 28

[3] S.K. Chan, and J.S. Tuba A Finite Element Method for Contact Problems of Solid Bodies Part 1: Theory and Validation, International Journal of Mechanical Sciences 13 1971 213 230

[4] D. Kono, T. Inagaki, A. Matsubara, and I. Yamaji Stiffness model of machine tool supports using contact stiffness Precision Engineering 37 2013 650 657

[5] M. Salgado, L.N. López de Lacalle, A. Lamikiz, M. Muñoa, and J.A. Sánchez Evaluation of the stiffness chain on the deflection of end-mills under cutting forces, Int. J. Mach Tool Manufacture 45 2005 727 739

[6] V.A. Kudinov Machines Dynamics 1967 Mechanical Engineering Moscow

[7] M. Law, Y. Altintas, and A.S. Phani Rapid evaluation and optimization of machine tools with position-dependent stability International Journal of Machine Tools and Manufacture 68 2013 81 90

[8] A.N. Golovko, and I.V. Golovko Optimal design parameters of a shaving hob for compensation of the systematic error in the gear-tooth profile Russian Engineering Research 33 2013 427 428

[9] I.P. Balabanov, and A.G. Kondrashov Shaping of cutting part of angle milling cutters with nonzero geometry World Applied Sciences Journal 30 2014 1731 1734

[10] E.A. Ryabov, and S.Y. Yurasov Creating a rigid model of solid end radius cutter in NX IOP Conf. Ser.: Mater. Sci. Eng 134 2016 012034

[11] E.A. Ryabov, S.Y. Yurasov, and O.I. Yurasova Parametric modeling of ball end mills Russian Engineering Research 36 2016 784 785

[12] E. Rivin, Stiffness and Damping in Mechanical Design, Marcel Dekker Inc, 1999.

[13] R. Whalley, and M. Ebrahimi Analysis, modeling and simulation of stiffness in machine tool drives Computers & Industrial Engineering 38 2000 93 105

[14] D.T. Huang, and J.J. Lee On obtaining machine tool stiffness by CAE techniques Int J of Mach Tool Manufacture 41 2001 1149 1163

[15] I. Garitaonandia, M.H. Fernandes, and J. Albizuri Dynamic model of a centreless grinding machine based on an updated FE model International Journal of Machine Tools and Manufacture 48 2008 832 840

[16] A.K. Shmakov, V. Mironenko, K.K. Kirishina, A.S. Stanislavchik, and V.V. Kotov Effect of the average velocity of the free part of the semifinished product on the process of pneumothermal forming in the superplastic regime Metallurgist 1-2 57 2013 8 12

[17] R. Akhatov, A. Govorkov, and A. Zhilyaev Software solution designing of The analysis system of workability of industrial product during the production startup of aeronautical products International Journal of Applied Engineering Research 21 2015 42560 42562

[18] G. Bianchi, F. Paolucci, P. Van den Braembussche, H. Van Brussel, and F. Jovane Towards Virtual Engineering in Machine Tool Design CIRP Annals - Manufacturing Technology 45 1996 381 384

[19] K.N. Rudakov FEMAP 10.2.0. Geometric and finite element modeling of construction 2011 KPI Kiev

[20] P.S. Goncharov, I.A. Artamonov, T.F. Khalitov, S.V. Denisikhin, and D.E. Sotnik NX Advanced Simulation, Engineering analysis 2012 DMK Press Moscow